Performance Improvement in DSR and Comparitive Analysis with DSDV, AODV, DSR

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Performance Improvement in DSR and Comparitive Analysis with DSDV, AODV, DSR

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under the supervision of

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May 20, 2016

Supervisor's Certificate

This is to certify that the work presented in the dissertation entitled *Performance Improvement in DSR and Comparitive Analysis with DSDV, AODV, DSR* submitted by *Rashmi Singh*, Roll Number 214CS3158, is a record of research carried out by her under my supervision and guidance in partial fulfillment of the requirements of the degree of *Master of Technology* in *Computer Science and Engineering*. Neither this thesis nor any part of it has been submitted earlier for any degree or diploma to any institute or university in India or abroad.

Ramesh Kumar Mohapatra

Declaration of Originality

I, *Rashmi Singh*, Roll Number *214CS3158* hereby declare that this dissertation entitled *Performance Improvement in DSR and Comparitive Analysis with DSDV, AODV, DSR* presents work carried out as a postgraduate student of NIT Rourkela and, to the best of my knowledge, contains no material previously published or written by another person, nor any material presented by me for the award of any degree or diploma of NIT Rourkela or any other institution. Any contribution made to this research by others, with whom I have worked at NIT Rourkela or elsewhere, is explicitly acknowledged in the dissertation. Works of other authors cited in this dissertation have been duly acknowledged under the sections "Reference" or "Bibliography". I have also submitted my research records to the scrutiny committee for evaluation of my dissertation.

I am fully aware that in case of any non-compliance detected in future, the Senate of NIT Rourkela may withdraw the degree awarded to me on the basis of the present dissertation.

May 20, 2016
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Aknowledgment

I am grateful to numerous local and global peers who have contributed towards shaping this thesis. At the outset, I would like to express my sincere thanks to Prof.Ramesh kumar Mohapatra for his advice during my thesis work. As my supervisor, he has constantly encouraged me to remain focused on achieving my goal. His observations and comments helped me to establish the overall direction to the research and to move forward with investigation in depth. He has helped me greatly and been a source of knowledge. I am also thankful to all the professors at the department for their support.

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Abstract

Mobile ad-hoc network is an infrastructure less wireless network which have group of hosts. To communicate, these hosts on behalf of one another they transfer the packets. In an ad-hoc network there are many routing protocol. The most popular one,out of them is dynamic source routing protocol(DSR).The most of the routing algorithms for MANET are designed for single source and single destination in the network. We have considered multiple source (two and three in our case) and single destination scenario. In our work we present some ideas or enhancements to the existing DSR protocol to make it more capable to tackle the above mentioned situation.

We have taken our hypothesis of multiple source acting in network along with a single destination for high mobility area. Under this kind of situation also the performance of our network changes, as the nodes are mobile so the reputed routes (efficient route) keep on changing all the time and almost all the routing protocols are not capable of using the best routes for the optimum time as it would stick to the once captured route despite of the available good routes. So in our protocol ExDSR (Extended DSR) we tried to overcome this problem. To evaluate the performance of our proposed work different simulations have been conducted, considering various possible network parameters. We compared our protocol with the existing ones like AODV, DSDV and DSR and this novel protocol has shown better performance than the existing protocols under the mentioned scenarios.

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Chapter 1

Introduction

1.1 Introduction

Mobile ad-hoc network (MANET) having different mobile users, which can communicate one another with relatively low bandwidth in wireless links. In network topology nodes are mobile which can randomly and change rapidly over time. Node can self executed the activity of network which have topology discovering and message delivering. The network is not in centralized manner, its a wireless device node connected with a radio and its a infrastructure less network based on IP. In the process, the node is like a router which help to forward the traffic to another specified node which do not depend on centralized administration process [1]. The meaning of “Ad-hoc” Is “for this purpose” which was a Latin phrase. In the field of computer network Ad-hoc is used for connection establishment for single session and it does not need a base station. From 1980’s the wireless cellular network has been in use. In a wireless system we seen three generation. There is a access point which was centralized can support the system work. When node roam from one place to another place the wireless user can connect to a wireless system with the help of access point. MANET is a system which was autonomous can connect all other mobile node in a wireless links; the nodes works as like routers and end system for a different node in network. A new technology will growing that we allow all users to access the information and services electronically, regardless with their geographical position.

Classification of wireless networks are of two types

i. Infrastructure less network

ii. Infrastructure based network

In a wireless network which was infrastructure less contains wired and fixed gateway. For a particular communication radius in the network there is a bridge also called base station all mobile host contact with these bridge. The mobile host goes out of range from a base station, then the host connect to the new base station and continuously the communication start through them, it is called handoff. Base station is fixed in this approach. For infrastructure mode wireless AP (access point) is needed. There is compulsory to join WLAN [2] use of same SSID (service set identifier) which was configured by wireless client and AP. After that AP is connect by a cable to the wired network to permit the wireless client access. To increase the support and infrastructure more number of wireless client additional AP can be added [3].

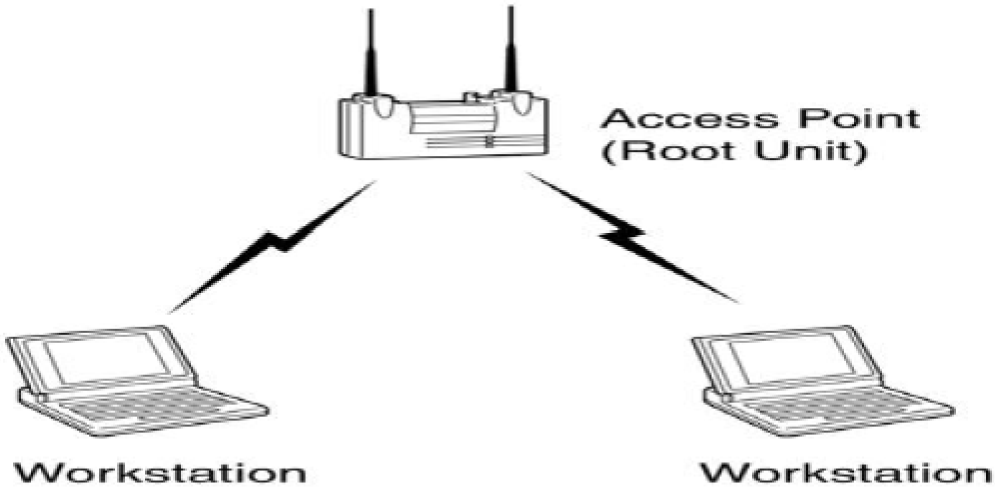

Figure 1.1: Infrastructure Wireless Network

In a wireless network all the mobile routers are connected by a wireless links and they are self configuring and the combination of all these routers create topology called a arbitrary topology. All the nodes which are participating works like an router. These router manage themselves and they are free to move; thus, the wireless network topology may change impulsive and rapidly. This type of network connected to a large internet or operate in individual fashion. MANET contains a independent node which can communicate with one

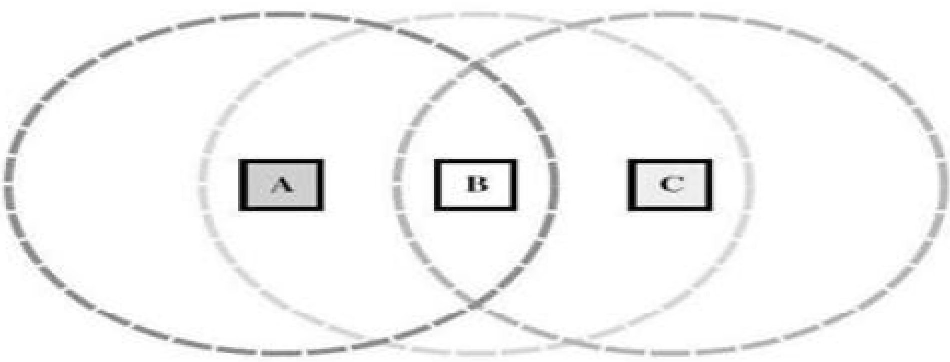

Figure 1.2: Simple Ad-hoc Network with Three Participating Nodes

another via a radio waves. In same radio range the nodes can communicate directly, and for other nodes it needs intermediate node to route their packet.

1.1.1 Types of mobile ad-hoc network

MANETs are of different types:

1. Intelligent vehicular ad hoc networks (InVANETs) – Its an artificial intelligence which is used to handle the situation like vehicle accident and collision [2].
2. iMANET - used to help to fix the problem of mobile node and link fixed by Internet Based Mobile Ad hoc networks.
3. Vehicular ad hoc networks helps to communicate road side equipment and enables effective communication.

1.1.2 Mobile ad-hoc network characteristics

- No infrastructure and centralized controller [4].
- Each node perform routers and hosts role both.
- Routing update frequently and dynamic network topology.
- Autonomous (no need of infrastructure).
- Wireless via communication means.
- Anywhere it can be setup.
- Computation and storage are limited.
- Limited security.

1.2 Mobile ad-hoc network application area

Application of mobile ad-hoc network are as follows:

- Police and military exercise.
- Operation of disaster relief.
- Operation of mine site.
- Imperative business meetings.
- Radio network.
- Commercial network eg 3G network.
- Robot data acquition.

1.3 MANET security problem:

MANET is more weaker then the wired network. There is a following reason:

- Cooperative algorithm – The interruption of network security there is a common trust between a nodes which is required by a routing algorithm.
- Lack of defense line – In a MANET there is no security layered as like in wired network.
- Open medium – In a wireless network it is easier to do eavesdropping as compare to wired network.
- Randomly changes in network topology – The node which are mobile in nature are moving from one network to another they are doing inside outside work, so the network allow any node for joining the network which may be malicious also without detecting it.
- No centralized monitoring – Its a infrastructure less no central agent was their that's why it not allow any monitoring agent for the system.

1.4 Merits of MANET

There are following types of advantages of MANET:

- Mobile ad-hoc network provide services and information to access it irrespective it was in geographic position.
- Mobile ad-hoc network work without any infrastructure which was pre-existing.
- Mobile ad-hoc network can be set up in any place and any time.

1.5 Demerits of MANET

There are following types of disadvantages [5]

- Physical security which was limited in case of MANET.
- Resources are limited.
- There is no authorization facilities.
- Difficult to find malicious node.

1.6 Current Scenario of DSR

In a ad-hoc wireless network DSR is a routing protocol. It is same as AODV in which it established on-demand route when ones a request come from transmitting mobile. DSR is source routing protocol, on-demand protocol, all information updated continually at mobile nodes. It does not depend on routing table DSR uses source routing [6].

Dynamic source routing protocol composed two mechanism “Route-maintenance” and “Route-Discovery”, it allow the network to completely self-organizing and self-configuring. When route maintenance and discovery work together then it maintain a routes of a arbitrary destination in MANET [4].

With the help of Route Discovery process for a communication we find the optimum path from source to destination node. For optimum communication path and loop free when any change in network conditions Route Maintenance take care of it, even if any modification during transmission [4]. when a message reached to destination then only Route Reply would be generated. For a Route Reply destination node having a route of the source. In the route cache already having the route, then the route would be used. Otherwise the node will reverse the route based on the route record in the Symmetric links or Route Reply message header. Route Maintenance Phase is initiated whereby the Route Error packets are generated at a node. Again, the Route Discovery Phase is initiated to determine the most viable route [7].

1.6.1 Merits and Demerits of DSR

- Dynamic source routing protocol does not need time to time flood the updated message all over the network its a reactive approach not a table-driven approach [8].
- Reduce control overhead.
- Broken link is not repair locally in the route maintenance mechanism.
- Low and static mobility area well performed.

Dynamic source routing protocol contain two phase:

- To find the path called Route Discovery [2].
- To maintain the path called Route Maintenance. Both two phase response when a request come.

Route Discovery

If the queue has route from source to destination then immediately this route be used [2]. If queue doesn’t have route then we use Route Discovery:

1 An initiator flood the packet of RouteRequest all over the network.

2 If the intermediate node already listed in route record or recently have RouteRequest from same target node then that node discard the current request.

3 If a intermediate node is a destination node it reply by sending RouteReply to a initiator which contain the best path from source to destination.

4 If its not target node then he send to its neighbor.

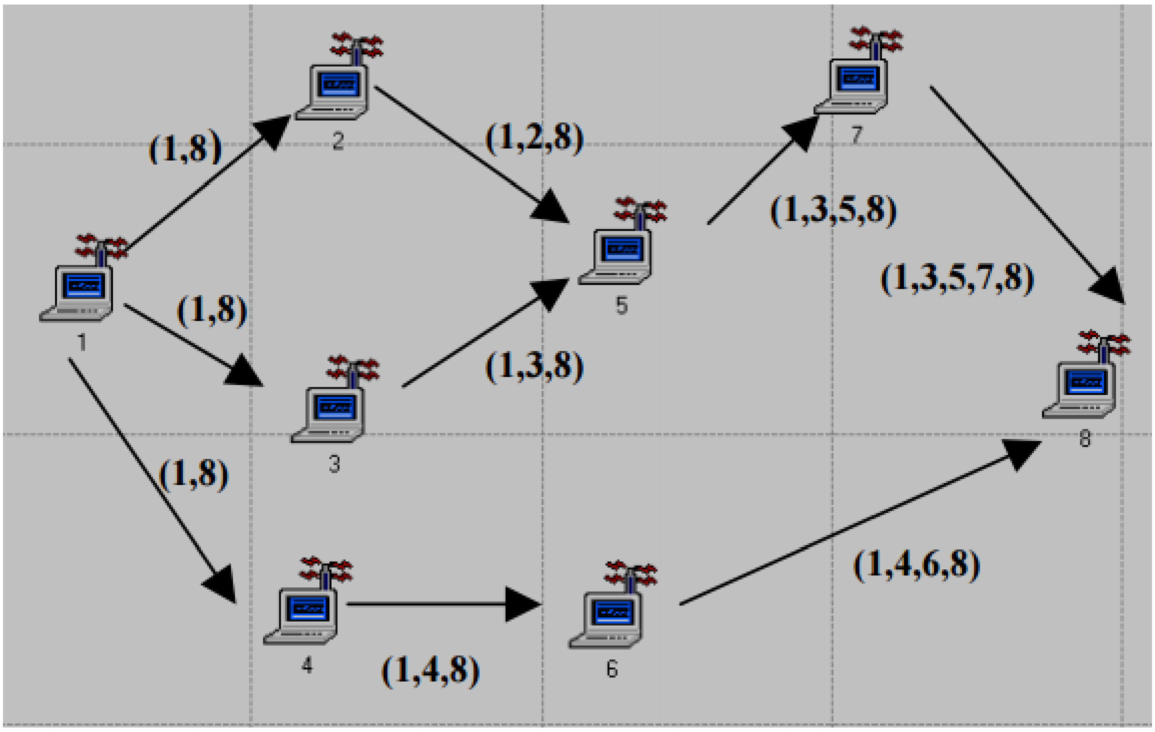

Figure 1.3: Route Discovery Example

Route Maintenance

DSR node always check that next hop receives the Source Route packet or not and packet forwarding once by a node [9]. If packet not received by node then some limited number time It retransmit the packet until they receive the confirmation message from next hop. After retransmission time is over it send RouteError message and remove the node from the queue. Then again source check route to the target.

1.7 DSDV

DSDV (Destination-Sequenced Distance-Vector Routing) is a table-driven routing scheme which is based on Bellman-Ford algorithm. Every node contain and maintain a table consists of all possible destination. The table contain the shortest known distance metric to that destination measured in hop counts, the address identifier of a destination and the address identifier of the node that is the first hop on the shortest path to the destination. All node maintain routing table which have recorded all possible destinations and number of hops. The route which contain highest sequence number is always used. DSDV update the table regular, which use more battery power and when the topology changes in the network then a new sequence number is compulsory before network re-converges. Thus, for high dynamic network DSDV is not suitable.

1.8 Motivation

In past year lots of improvement in the routing protocol so question is that why we select DSR as our research protocol. In wireless network area illustrate that dynamic source routing protocol outperform the ad-hoc on demand distance vector routing protocol in case of high mobility area and increment number of nodes movement speed and the mobility performance are same in the case of AODV and DSR [10]. But the different routing packet overhead transmission requires high node mobility rates which was more expensive than DSR.

1.9 Problem statement

In recent years many new versions of the DSR (other protocols also) have been proposed like E-DSR (Enhanced DSR) [11]. It basically works on abandoning the redundant RREPs and the control packets overheads, hence gives out better performance at certain condition. Then for power line sensor network the I- DSR (improved DSR) [12] was proposed in IEEE proceedings. Also a New DSR [13] [10] which allows specific nodes to participate in communications with a threshold battery power were proposed. A-DSR (Advance DSR) which work in low mobility area.

1.10 Objective

Almost all the improvements on DSR so any other protocols are given for single source and single destination. We are considering a different practical aspect of multiple source and single destination. We are going to improve the DSR protocol for multiple source and single destination where both are having common best path.

1.11 Thesis Organization

Thesis is organized as follows. Chapter two describes literature survey. Chapter three describes the proposed method of improving DSR protocol. Chapter four includes simulation result and finally chapter five conclusions and future work.

Chapter 2

Literature Survey

2.1 Routing in MANET

For a particular topology to find a route and maintain or update the route we can use routing. Overall there are many routing protocol to calculate, maintain and discover routes, to maintain a algorithm of a protocol we need some metrics like a number of hops to find the best path for routing purpose. Fundamentally two exercises are included in this idea: deciding optimal routing paths (relies on upon measurements) and transferring all the packets. Routing protocol take measurement for the estimation of best path selection routing for the packet of the destination having different hops of different number, which are utilized by a algorithm of routing decide the destination packet. For different routing algorithm the information of rotes varies. IP-address prefix and next hop are two contain which was present in routing table.

In a mobile ad-hoc network, routing we classified it into two types static-dynamic routing. The alludes of static routing is that routing can be expressed physically or statically. Static routing preserves up a routing table typically composed by a network administrator. In a network the table of routing doesn't count on the status of network, to tell that the destination we choose is dynamic or not. Dynamic routing can refer the technique of routing in which it can learnt by a interior outside directing convention. The routing table is predisposed liveliness of the destination [14].

Network the structure will change dynamically, in a mobile ad-hoc network system is a self organizing and self configuring. This is primarily because of the nodes. In the networks nodes will be exploit same channel of wireless system which was select randomly, which can collaborating it friendly way to engaging itself in a manner of multi-hop. networks node behave hosts and routers both, which routes the data from one to another [6]. MANET is a system in there is no need of any structure in the case of wireless network, when any node is go from out of range from source node to transfer packet then there is no need of routing procedure. To forward the packet from source to destination there is always ready to search the path. In a single cell one base station is their which can connect with all the mobile node of that cell. In a cell without broadcast the route in same network of wireless. In MANET 1 node can be forward the data to other nodes. For these many other problem can be generated for dynamic topology which was not predictable for changes [6].

2.1.1 Properties of Ad-hoc Routing Protocols

i Loop free: To avoid misuses of bandwidth or CPU consumption, routing protocol give a assurance that route supplied are loop free, which improve the overall performance.

ii Distributed operation: In the network the protocol will not be centralized the node of one not depend on another node not single node control other all node in the cell, it will be distributive in nature. The network will partitioned easily and the node will enter or leave the cell in networks.

iii Power conservation: There is shortage or limitation of battery power, In a ad-hoc network the nodes can be movable device like laptop or other items. so we need some mode which can save power. therefore sleep mode will be there in a protocol.

iv Demand based operation: To protect our resource its a issue how to control the misuse of different resources and control the overhead. For that at no need of particular period of time broadcast the information only when it need then only they react.

v Multiple routes: In a network there is a possibility that route that was selected was invalid, When a 1 route may be become invalid, there is a possibility that other route which was store may be valid. To avoid multiple congestion and number of reaction to topological changes use a routes. From these we can help to start with initial work of route discovery procedure.

vi Quality of Service Support: In every protocol of routing contain some quality of service, which help to known what the procedure the network use in a real time.

vii Security:In a environment of radio there are different types of attack which was defenseless, for insurance of security we have to check the protocol behavior. There are two ways first one encryption and another one authentication which help to solve this kind of problem. The problem is with the key which was been distributed between the nodes in the network.

viii Unidirectional link support: In the environment of the transfer of packet will be held on unidirectional links. so by using bidirectional link improve the performance of routing protocol.

2.1.2 MANET - Problems with routing

i Dynamic Topology: In a network mobile node was movable or there medium characteristics may also be change, which means topology is not constant. In topology the changes must reflect on the routing table in ad-hoc network and adaptation of routing algorithm. Example routing table can updated in a fixed network for every 30 sec. which can be low frequency updating for ad-hoc networks.

ii Routing Overhead: In a MANET the node are mobile in nature so their location was also changes. From that some time it generate outdated routes in the routing table so a overhead create in routing table which was unwanted.

iii Asymmetric links: The links in the wired network is symmetric but in the mobile network the node change their position so they do not depend on symmetric links.

iv Interference: In MANET links can be depend on the incoming and outing transmission, when there is a inference between two different links or there is a overlapping between different link than the total transmission can be corrupt.

2.2 MANET - Classification of Routing Protocol

Routing protocol is depend on structure of network and routing stategy. There are 3 types of routing Flat, hierarchical and geographic routing protocol via [7]. The classification strategy will depend on source initiated, table driven [15] [16] [1]. The classification shown in the figure below-

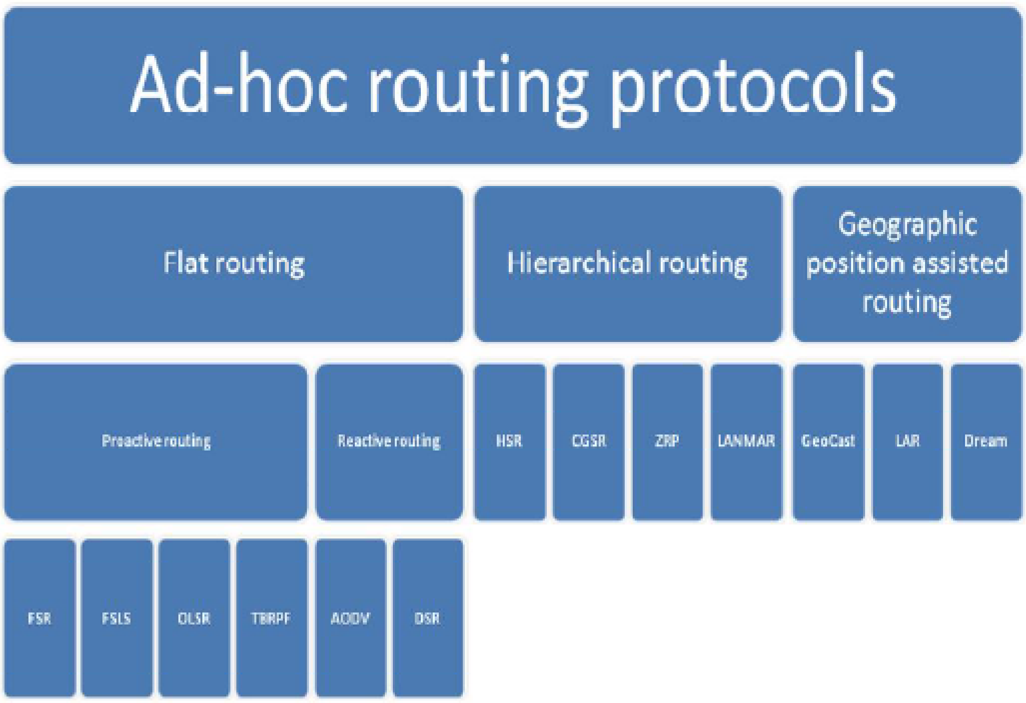

Figure 2.1: Classification of Routing Protocols in MANET

2.2.1 Flat Routing Protocol

In a Flat routing the protocol is classified into two type of classes; first is proactive/table driven protocol and second is on-demand/reactive protocol. In both the classes the node participation play a equal role. There is further classification on basis of design principle. The proactive based on link state and on-demand is based on distance vector routing.

Pro-Active / Table Driven routing Protocols

Table-driven or pro-active protocols which determine the layout of overall outline of network. In the network topology the exchange a packet for a single node maintain the network by check complete picture of network. Therefore there is minimal delay in the route which is use full for time-critical traffic.

In the network when the information of routing become worthless rapidly, different short time lived routes are there which can turn invalid before they not used. so, increasing of mobility more traffic will generated, unnecessary routes evaluation traffic overhead will generate [16]. When the size of network increases they altered. control traffic total portion will be further decreased which contain practical data. If the information of nodes transmission is irregular then it dismissed the information. However, to updating the unused entries we expand the energy in the routing table. For MANET energy conservation is important. So, we cannot expend more expenditure for energy. Thus, for low mobile network pro-active protocol is best. Some examples of pro-active protocol contain

- FSR: Fish-eye State Routing
- OLSR: Optimized Link State Routing
- DSDV: Destination-Sequenced Distance Vector
- CGSR: Cluster-head Gateway Switch Routing Protocol

Reactive (On Demand) protocols

Wireless device like mobile, palmtops or notebooks are mobile nodes. The mobility of nodes in the ad-hoc network is a important issue. The topology of a network constantly change because of mobility of nodes. To track the mobile node is not easy task, in a signaling many resources consumed. For these type enviroment reactive routing protocol were intended. There is no need of take entire image of network topology for design purpose because of constant changes. To find the path for a given target we use root discovery process [17].

Reactive protocol is based on on-demand work ,it sets the routes when any node want to communicate with other node and they don't have routes. Reactive protocol use two types of message route reply message(RREP) and another is route request message(RREQ). To discover the route from source to destination with the help of route request we send message

; when the destination gets the route request message then it send a route reply message to show that the route has confirmed established. For network like single rate reactive protocol is very effective. Reactive protocol help to select the path way to minimizes the number of hops. In a multi-rated networks throughput of the path in which number of is minimum is not so important. The Reactive routing/On Demand driven protocol are following types:

- ABR: Associativity Based routing
- LAR: Location-Aided Routing Protocol
- SSA: Signal Stability-Based Adaptive Routing
- TORA: Temporally ordered routing algorithm
- DSR: Dynamic Source routing protocol [18]
- AODV: Ad hoc On Demand Distance Vector

2.2.2 Hybrid Routing Protocols

Hybrid routing is the combination of above two protocol they both have different in nature. Hybrid work for both small domains and outside the domains. Example are as follows:

- WARP: Wireless Ad hoc Routing Protocol
- ZRP: Zone Routing Protocol

2.2.3 Hierarchical Routing Protocols

Hierarchical protocol is preferable when network size is increases and they produce large number of overhead in flat routing protocols.

- LANMAR: Landmark Ad Hoc Routing Protocol
- HSR: Hierarchical State Routing
- CGSR: Cluster-head Gateway Switch Routing Protocol
- ZRP: Zone Routing Protocol

2.2.4 Geographical Routing Protocols

The protocol called geographical routing it advantage is that it prevent from wide network searches for a destination. There is a coordinates in the geographical routing if we known these coordinate then we control and data packet is send to destination for general purpose. In a geographical routing there is a disadvantage that it access all the node at all the time to make geographical routing protocol useful. The capacity of updating of route is faster then the mobility rate of a network when we consider location-based effective routing. Example of this protocol is:

- GPSR (Greedy Perimeter Stateless Routing)

2.3 Proactive routing protocol (Table-driven) and Reactive routing protocols (On-demand) comparison

Comparison of Table-driven and On-demand routing protocol are shown in the following table[2]

Proactive routing	Reactive routing
Maintain information updation time to time	When required then information update
Periodically information updated	No need of periodically updation
Power consumption is more and heavy traffic	Power consumption is less and low traffic
Latency of first packet is less	Latency of first packet is more
Routes are available for a nodes any time in the MANET	Not necessary

Chapter 3

Methodology

As per the problem statement it is apparent that DSR as its primitive form is unable to find the best available path. Once it has captured any momentary best path. DSR is continued to follow the same path which it has detected earlier. To solve his problem we are making DSR to switch to a new path, which is better than the previous one this can be achieved in the following manner:

i Root discovery at periodic interval: The node would periodically search for any new root changed/available currently. If there is a new root with better metrics or path weight the node will update their path information queue. If a new path is found the switching would be done to vary the path.

ii Medium sense at periodic interval: In case of multitasking/multiprocessor system, a system call can be made at regular interval to detect the traffic in the channel. If it finds the traffic is the less congested then the previous record a new root discovery would be made and switching will be done.

3.1 Problem Statement

As mentioned in the introductory part that there have been other derivatives of DSR protocols, proposed in recent years like E-DSR [23], which was based on reducing the routing overhead of the rudimentary DSR by abandoning redundant RREPs and the control packet overheads. Then for power line sensor network the I- DSR (improved DSR) [24] was proposed in IEEE proceedings. Also a New DSR which allows specific nodes to participate in communications with a threshold battery power were proposed. Also there is MP-DSR (Multi path DSR) which provides soft QoS guarantees with respect to end-to-end reliability by discovering a set of multiple disjoint paths and transmitting data along these paths. Unlike almost every research paper we are considering a small scenario of having multiple source nodes (at least 2) and a single destination node in our ad-hoc network. In our practical scenario the movement of nodes are very less, means we have kept the pause time very high then the protocol ExDSR outperformed all protocol DSDV, AODV, and DSR. Also we have conducted comparatives of ExDSR with DSR, DSDV, and AODV under different conditions with multiple nodes and variations in movement then also we found at few parameters it outperforms the others.

DSR Algorithm for Multiple Source & Common Best Path

1 A1 and A2 are two source node.

2 A1 have an start up process then it start transmission.

3 To transmit the startup info search best available path P1 and occupied.

4 A1 start transmission any intermediate process started which monitored by source A2.

5 To find best available path for A2 node send an RREQ packet.

6 The best available path is occupied by A1 already.

7 Now P2 secound best path available which was less efficient then P1.

8 When A1 finish transmission P1 path free.

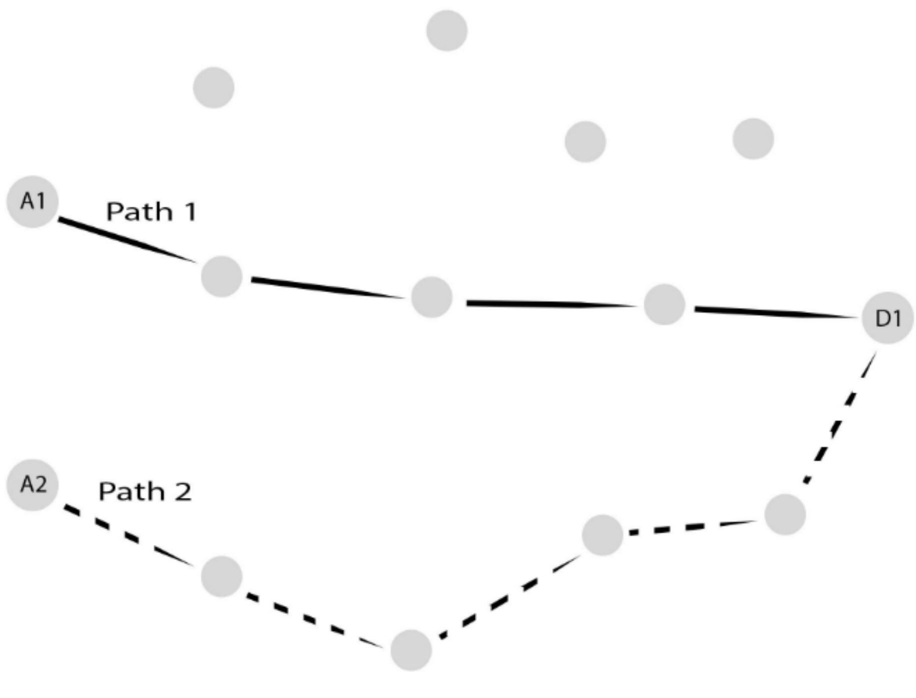

Figure 3.1: Multiple Source and Common best Path Scenario

9 But A2 never switch to p1 path although the route get fail [16].

10 If we make any algorithm which can help to switch the path means A2 get path P1 between transmission not in case of network failure?

11 So we need to improve our protocol which help in path switching to get an optimum performance from an protocol.

3.2 Proposed Solution

As per the problem statement it is apparent that DSR as its primitive form is unable to find the best available path. Once it has captured any momentary best path. DSR is continued to follow the same path which it has detected earlier. To solve his problem we are making DSR to switch to a new path, which is better than the previous one this can be achieved in the following manner:

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8 When A1 finish transmission P1 path free.

9 Before A1 finish transmission it will send ACK like packet to all its neighbor node which treat as like unmasked interrupt for A1 and ACK packet contain route metric information.

10 The metric come with modification, again check the path if P1 » P2.

11 The node leave the path and switch it into best one path.

12 We get best performance.

Changing the path the performance of throughput, packet delay reduces as compare to existing one.

Chapter 4

Simulations & Results

4.1 Network Simulator

Network simulator or NS-2.34 is started by 1989 to simulate discrete-event. At starting NS -2 simulate only for wired technology but Department of computer science at University of Rice Monarch group develop a software which was an extension of original work for mobile host and wireless. This is accepted widely and add in the ns version called NS-2.34 [19]. NS-2.34 have employ two languages.
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4.2 Simulation Setup

To analysis the performance we installed the operating system 64-bit Ubuntu in an intel core i3, 2.13 GHz, installed network simulator NS-2.34 in platform. Many parameter have used for different protocol during simulation.

4.3 Performance Metrics Used

Analysis of AODV, DSR, DSDV and EXDSR the following types of metrics use:

i. NRL: Normalized Routing Load

ii. E2E: Average End to End Delay

iii. PDF: Packet Delivery Ratio

iv. Throughout

Parameter	Value
Routing Protocol	DSDV/AODV/DSR/ExDSR
MAC Type	802.11
Transmission range	450m
Simulation time	120,140,160,180,200,220 sec
Queue length	50
Traffic type	CBR
Topology size	1500x1500
Number of nodes	9-10
Packet size	512 bytes
CBR Rate	600 kbps

Table 4.1: General Parameters used in simulation

Normalized Routing Load

During simulation routing packet generated number of packet is an routing overhead and defined as:

$$\textbf{Overhead} = \sum \textbf{Overhead}$$

Equation 4-1: Overhead Calculation

Average End-to-End Delay

When an CBR packet sent and received there is an difference in time. There is an delay due to route discovery mechanism latency will change during buffering, due to in an interface queue there is an queuing and because of retransmission [20]. There is an difference between sent and receive time at CBR which divide by total record time.

$$\textbf{Avg E2E Delay} = \sum_1^n \textbf{CBRsentTime - CBRrecvTime} / \sum_1^n \textbf{1n CBRrec}$$

Equation 4-3: Average End to End Delay

Packet delivery ratio

The PDR is the total sum of the packet recive by the sink which was CBR type divide by the number packet sent by the source which was an CBR type in the simulation.

$$\textbf{PDR} = \sum \textbf{Packet Received by Sink (CBR type)}/ \sum \textbf{Packet Sent by Source (CBR type)}$$

Equation 4-1: Packet Delivery fraction

Throughput

To calculate an throughput means we have to calculate how much the message delivery is successful over an communication channel. Through logical or physical link this data can be deliver. which can also may be pass through network node. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time slot.

Average Throughput[kbps] = (RecievedSize / (stopTime – startTime)) * (8/1000)

Equation 4-4: Calculation of Average Throughput

4.4 Comparisons and Results

There were many simulation scenarios depending upon number of source node, intermediate nodes, movement of nodes and direction of movements etc but we chose some specific ones for our experiments. In order to evaluate the performance of ad hoc network routing protocols the following scenarios were considered :-

4.4.1 Scenario1: Nodes with High Pause Time

Here in this case the there are two source nodes getting activated at different time. You may see the initial topology here in the figure given below. Here source 1 (node 2) start its transmission at 1.4 second using a constant CBR source. It selects the path 2-3-1 (say p1)(1 is destination). Now at time 1.8 second another source 2 (here node 0) start its transmission and choses the path 0-7-1 (say p2). Now at time = 2.5 second the source 1 stops it's transmission.

How path p1 is better than p2

We tested this by making on only one source either 1 or source 2. Initially the simulation is run by making source 1 (node 2) enable first as in our regular scenario. Then it chose path 2-3-1 (p1). Now reverse the situation switch on the source 2 first keep source 1 off, then also node 0 (source 2 choses the same path 2-3-1. Hence it shows that the path p1 is better than the path p2 for both the sources. Figure-4.1

Source1 starts first and source2 after that and follows second best path.Figure-4.2

DSDV simulation

The given table depicts the different results on Source1 stops sending source1 still on second best path (DSR).Table-4.4.1

AODV simulation

Under the same simulation range we tested the AODV protocol and got the following result:Table-4.4.1

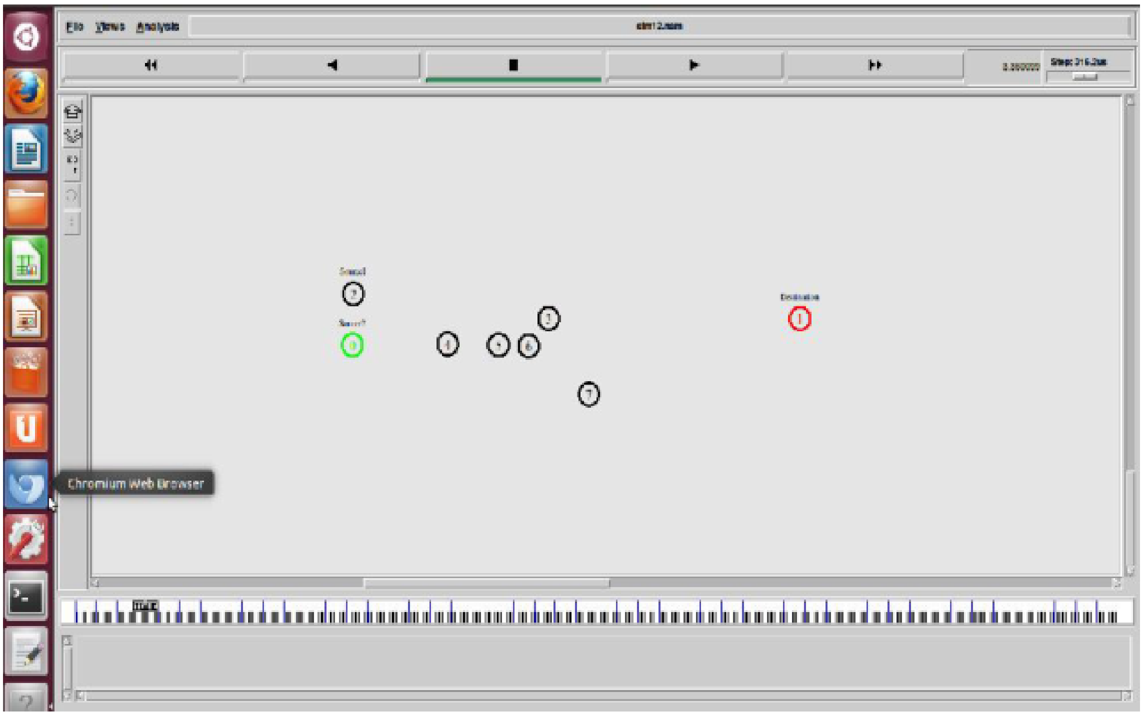

Figure 4.1: Initial Topology

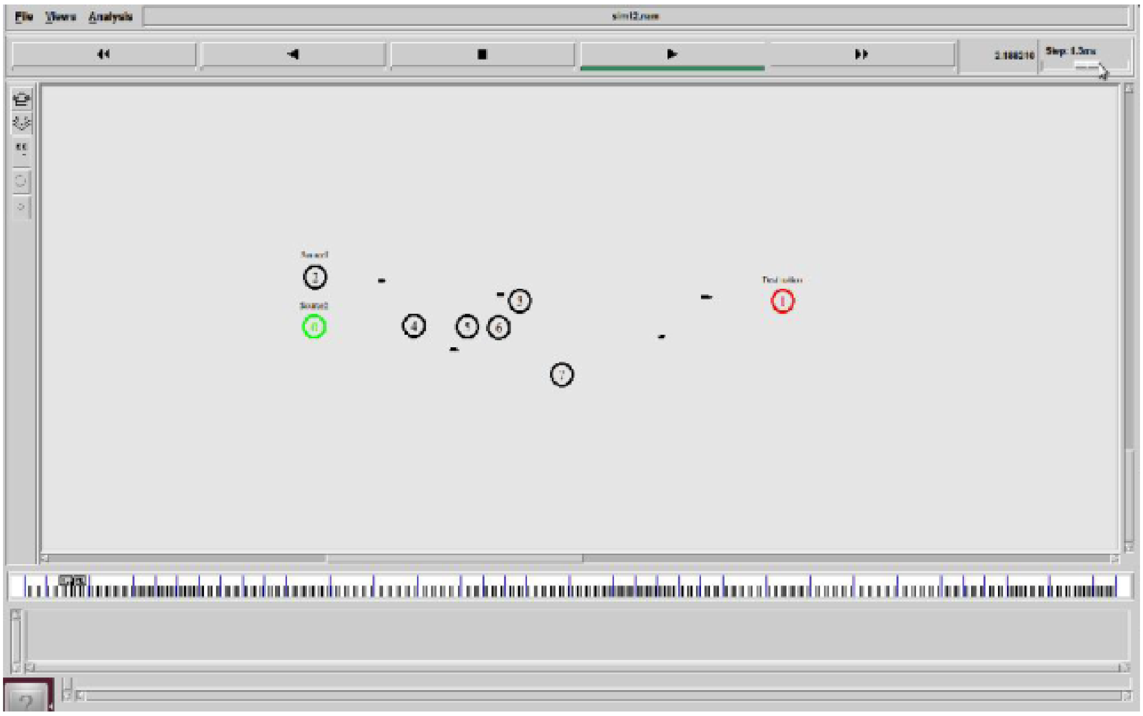

Figure 4.2: Two different path chosen by different source.

DSR simulation

Source1 stops sending source1 still on second best path (DSR).Table-4.4.1 and Fig-4.3

DSDV simulation times (in Sec)						
Parameters	120	140	160	180	200	220
Sent	17419	20349	23279	26208	29138	32068
Recv	10180	13109	16039	18969	21898	24828
Routingpkts	0.0	0.0	0.0	0.0	0.0	0.0
PDF	158.44	64.42	68.09	72.38	75.15	77.42
NRL	0.0	0.0	0.0	0.0	0.0	0.0
Average e-e delay(ms)	5.99	5.99	5.99	5.99	5.99	5.98
No. of dropped data (packets)	7239	7239	7239	7239	7239	7239
No. of dropped data (bytes)	385134	385134	385134	385134	385134	385134
Average Throughput(kbps)	351.58	387.42	414.23	435.03	451.64	465.22

Table 4.2: Simulation Result of DSDV under high pause time.

AODV simulation times (in Sec)						
Parameters	120	140	160	180	200	220
Sent	17419	20349	23279	26208	29138	32068
Recv	17377	20307	23237	26167	29096	32026
Routingpkts	0.0	0.0	0.0	0.0	0.0	0.0
PDF	99.76	99.79	99.82	99.84	99.86	99.87
NRL	0.0	0.0	0.0	0.0	0.0	0.0
Average e-e delay(ms)	12.35	11.43	10.74	10.21	9.78	9.43
No. of dropped data (packets)	41	41	41	41	41	41
No. of dropped data (bytes)	21812	21812	21812	21812	21812	21812
Average Throughput(kbps)	600.17	600.14	600.13	600.11	600.10	600.09

Table 4.3: Simulation result of AODV under high pause time/ Low movement

DSR simulation times (in Sec)						
Parameters	120	140	160	180	200	220
Sent	17419	20349	23279	26208	29138	32068
Recv	17369	20299	23229	26159	29088	32098
Routingpkts	24	24	24	24	24	24
PDF	99.71	99.75	99.79	99.81	99.83	99.84
NRL	0.0	0.0	0.0	0.0	0.0	0.0
Average e-e delay(ms)	12.49	11.55	10.85	10.30	9.87	9.51
No. of dropped data (packets)	48	48	48	48	48	48
No. of dropped data (bytes)	25668	25668	25668	25668	25668	25668
Average Throughput(kbps)	599.90	599.91	599.92	599.93	599.94	599.94

Table 4.4: DSR protocol under very low motion scenario

ExDSR simulation

Look in the picture below how ExDSR changes it's path once the path is rnunciated by source 1.table-4.4.1 Fig-4.4

Figure 4.3: DSR protocol under very low motion scenario

ExDSR simulation times (in Sec)						
Parameters	120	140	160	180	200	220
Sent	17477	20407	23336	26266	29196	32126
Recv	17416	20346	23276	26205	29135	32065
Routingpkts	24	24	24	24	24	24
PDF	99.65	99.70	99.74	99.77	99.79	99.81
NRL	0.0	0.0	0.0	0.0	0.0	0.0
Average e-e delay(ms)	16.14	14.67	13.58	12.73	12.05	11.49
No. of dropped data (packets)	59	59	59	59	59	59
No. of dropped data (bytes)	31520	31520	31520	31520	31520	31520
Average Throughput(kbps)	601.51	601.29	601.13	601.00	600.90	600.82

Table 4.5: ExDSR simulation result under low moboility (negligible) condition

PDF-Packet Delivery Ratio

Here is the comparatives of all protocols for the parameter.Table-4.4.1 Figure-4.5

E2E delay-Average End to End Delay

Here is the comparatives of all protocols for the parameter.Table-4.4.1 Figure-4.6

Figure 4.4: ExDSR Switches to path p1

Sim Time	DSDV	AODV	DSR	ExDSR
120	158.44	99.76	99.71	99.65
140	64.42	99.79	99.75	99.78
160	68.90	99.82	99.79	99.80
180	72.38	99.84	99.81	99.89
200	75.15	99.86	99.83	99.98
220	77.42	99.87	99.84	99.99

Table 4.6: PDR/PDF under low mobility condition vs Simulation time

Sim Time	DSDV	AODV	DSR	ExDSR
120	5.99	12.35	12.49	11.14
140	5.99	11.43	11.55	10.67
160	5.99	10.74	10.85	10.58
180	5.99	10.21	10.30	10.13
200	5.99	9.78	9.87	7.05
220	5.98	9.43	9.51	8.49

Table 4.7: Average E2E Delay vs Simulation time

Throughput

Below is the result of the throughput under the same scenario in kbps.Table-4.4.1 Figure-4.7

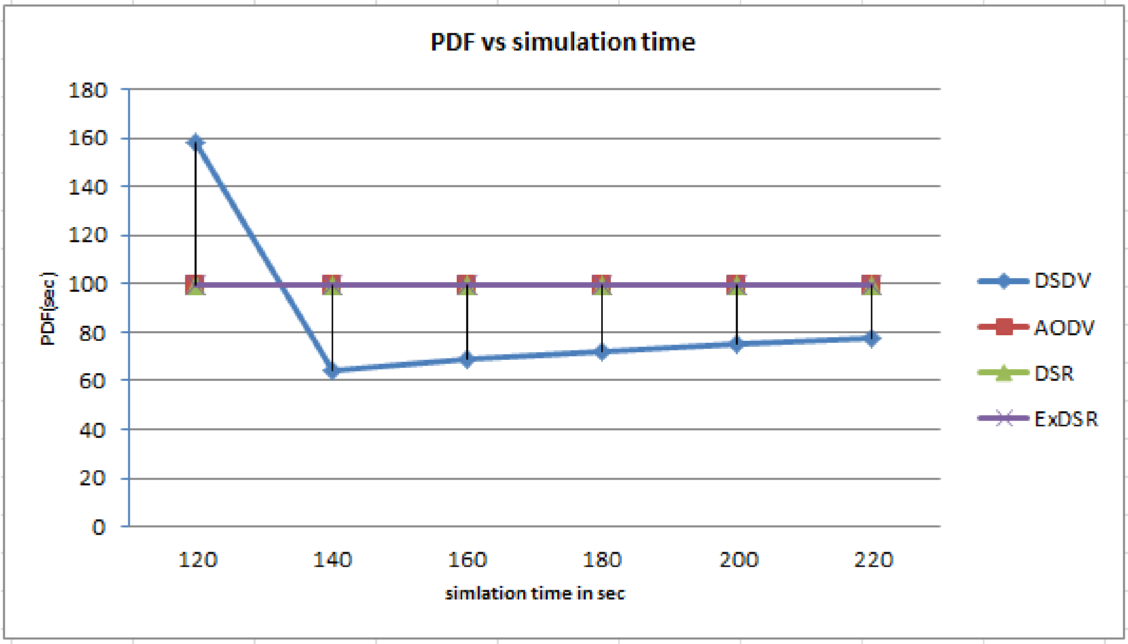

Figure 4.5: PDF vs simulation time

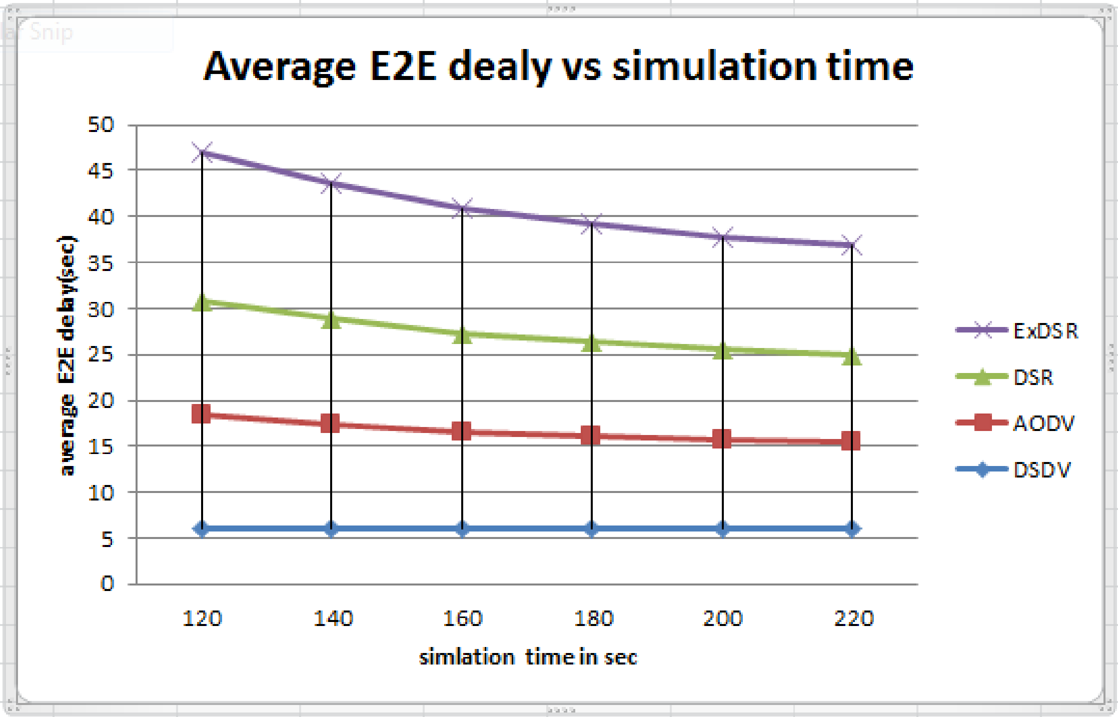

Figure 4.6: E2E Delay vs simulation time

4.4.2 Scenario 2: Only Source Nodes are Moving

In this scenario the remaining nodes except sources are kept stagnant or at high pause time. The source 1 and source 2 moves upward. The node final position and speed can be set by a tcl command. The transmission condition is still the same as previous scenario that source 1 will start first and then the source 2 will start. Here the route switching will happen

Sim Time	DSDV	AODV	DSR	ExDSR
120	351.58	600.17	599.90	601.51
140	387.42	600.19	599.91	601.29
160	414.23	600.13	599.92	601.13
180	435.03	600.11	599.93	601.00
200	451.64	600.10	599.94	600.99
220	465.22	600.09	599.94	600.82

Table 4.8: Throughput vs Simulation time

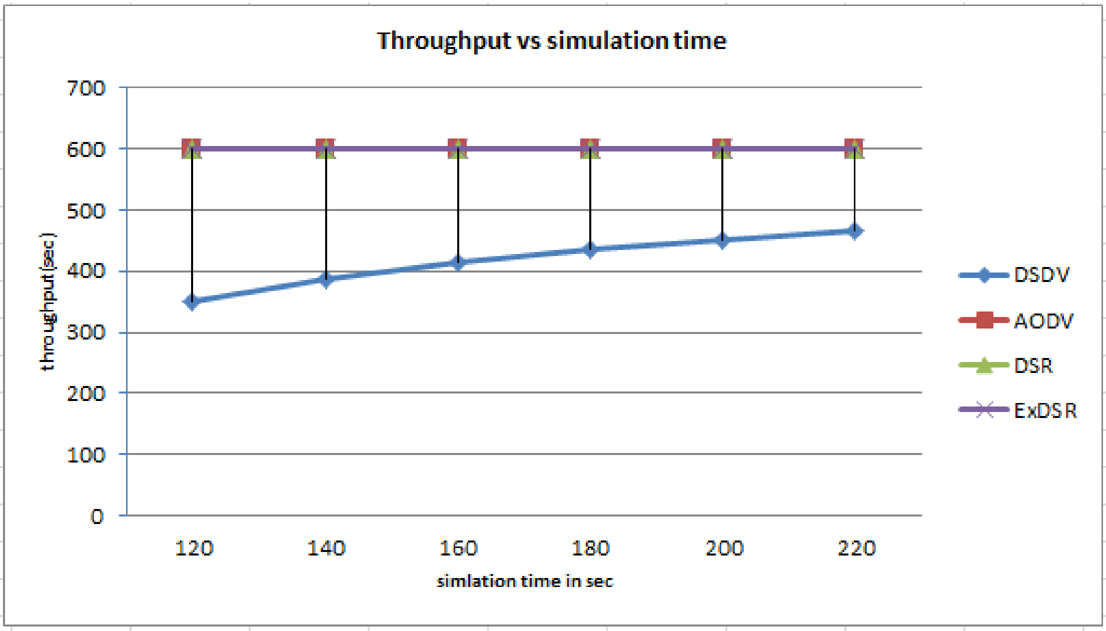

Figure 4.7: Throughput vs simulation time

only if the previous path gets broken due to substantial gap between the nodes as sources are moving. But ExDSR will do the switching the moment it finds the best path empty by acknowledgment of source 1.
./destination –X –Y –speed
Here we have kept the test speed of 15 m/sec, assigned to each source. So in this scenario the simulation results of the protocols are-

PDF-Packet Delivery Ratio

Packet Delivery Fraction of all protocols while source nodes are moving upward.Table-4.4.2 Figure-4.4.2

E2E delay-Average End to End Delay

This table contains the simulation results of average end to end delay of network when only source nodes are moving and different start time of sources also at some point 2.5 sec the

Sim Time	DSDV	AODV	DSR	ExDSR
120	13.96	73.94	99.74	99.84
140	24.43	99.78	99.75	99.89
160	30.48	73.68	99.79	99.83
180	36.51	99.59	99.81	99.86
200	42.89	73.51	99.83	99.98
220	48.11	73.46	99.84	99.99

Table 4.9: Packet Delivery Fraction vs Simulation Time

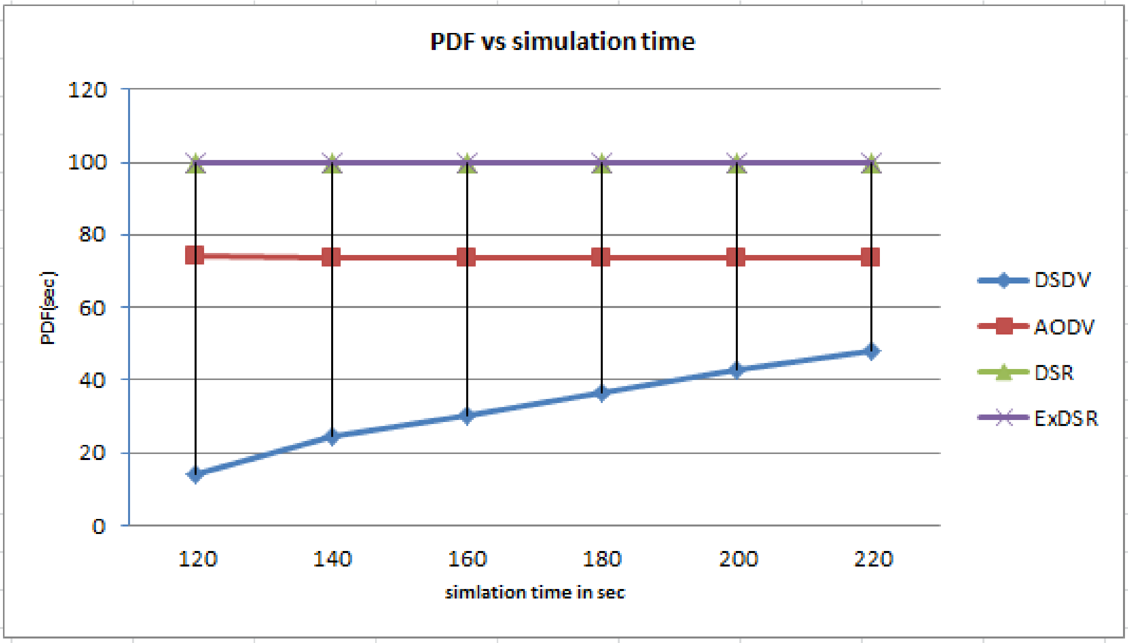

Figure 4.8: PDF vs simulation time

source 1 stops transmitting. Table-4.4.2 Figure-4.9

Sim Time	DSDV	AODV	DSR	ExDSR
120	6.02	452.85	13.18	15.33
140	96.13	456.44	12.14	11.84
160	206.76	459.06	11.36	10.72
180	236.92	461.12	10.76	10.11
200	182.80	462.94	10.28	9.17
220	149.22	464.29	9.88	9.60

Table 4.10: Average E2E Delay vs Simulation time

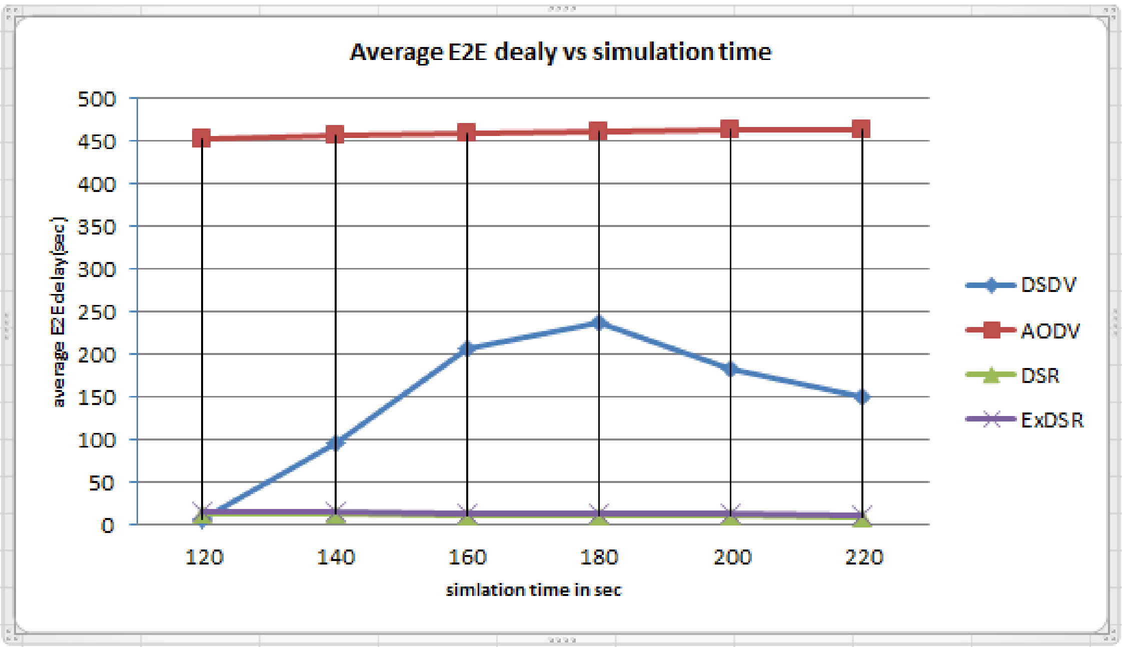

Figure 4.9: E2E Delay vs simulation time

Throughput

Below is the result of the throughput under the same scenario in kbps.Table-4.4.2 Figure-4.10

Sim Time	DSDV	AODV	DSR	ExDSR
120	83.96	444.87	599.89	601.44
140	146.92	443.68	599.91	601.23
160	183.24	442.96	599.92	601.08
180	219.46	442.31	599.93	600.96
200	257.77	441.75	599.31	600.86
220	289.08	441.39	599.94	600.78

Table 4.11: Throughput vs Simulation time

4.4.3 Scenario 3: All Nodes are moving on same direction with More Source

In this scenario we increased one more source and all the nodes including intermediate and destination all are moving upward. Here also we have kept the test speed of 15 m/sec, assigned to each source. All sources are continuously forwarding packet. So in this scenario the simulation results of the protocols are-

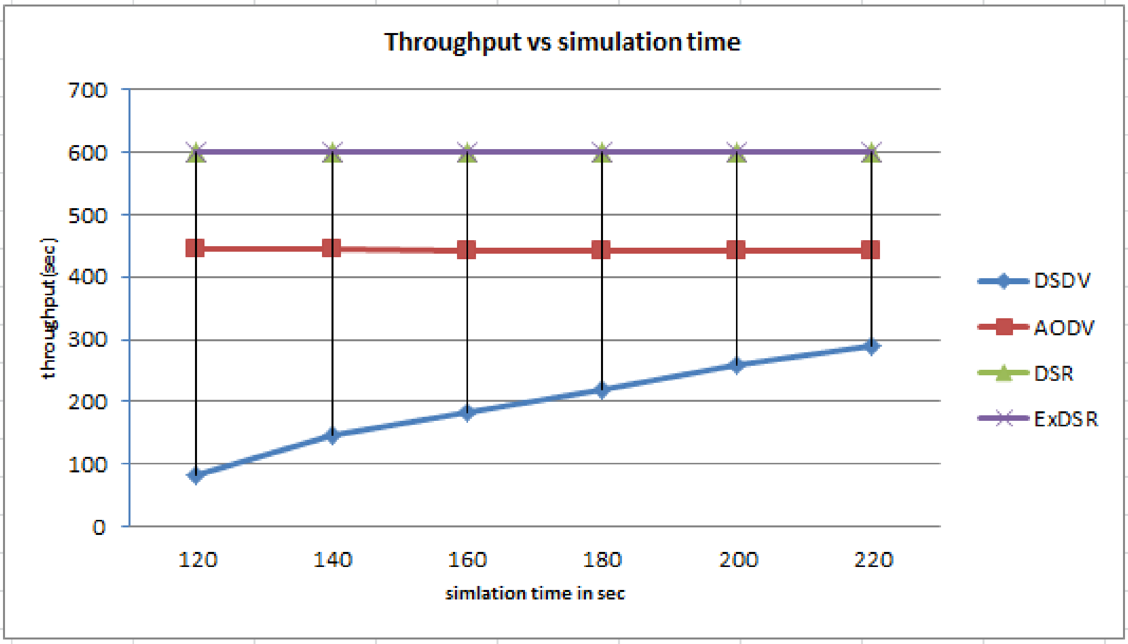

Figure 4.10: Throughput vs simulation time

PDF-Packet Delivery Ratio

Packet Delivery Fraction of all protocols while source nodes are moving upward. Table-4.4.3 Figure-4.11

Sim Time	DSDV	AODV	DSR	ExDSR
120	33.1	37.67	38.48	34.82
140	33.63	37.62	38.22	35.01
160	33.93	37.59	38.11	35.16
180	34.30	37.47	38.02	35.28
200	34.27	37.45	37.91	35.28
220	34.54	37.45	37.83	35.46

Table 4.12: PDF vs Simulation time

E2E delay-Average End to End Delay

This table contains the simulation results of average end to end delay of network when only source nodes are moving and different start time of sources also at some point 2.5 sec the source 1 stops transmitting.Table-4.4.3 Figure-4.12

Throughput

Below is the result of the throughput under the same scenario in kbps. Table-4.4.3 Figure-4.13

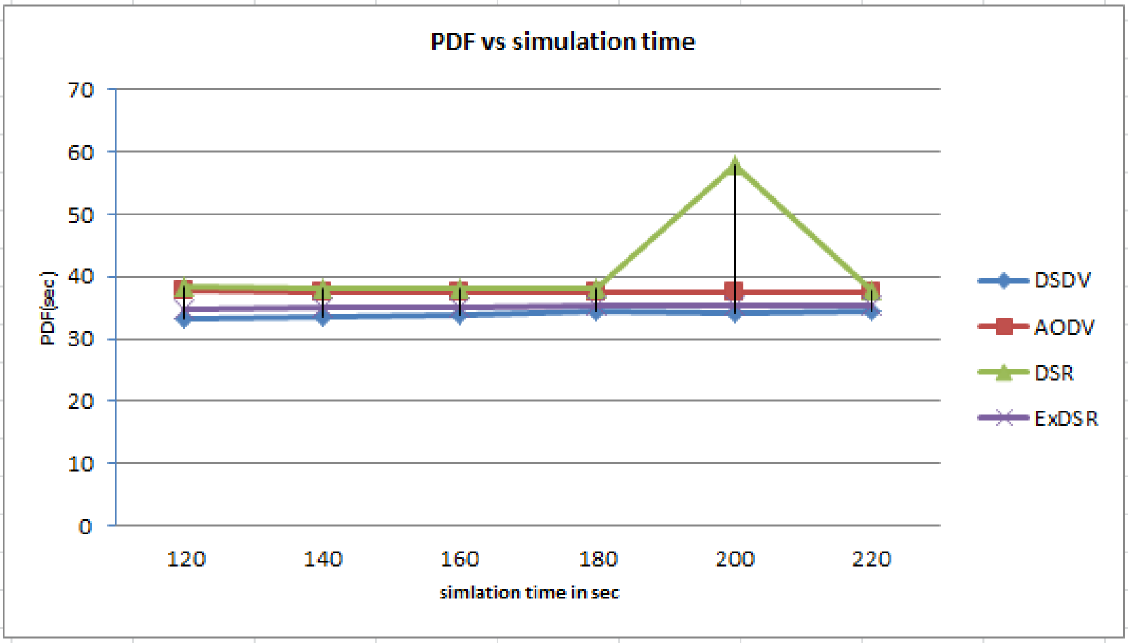

Figure 4.11: PDF vs simulation time

Sim Time	DSDV	AODV	DSR	ExDSR
120	552.35	551.99	572.52	695.37
140	553.53	551.99	573.00	688.54
160	552.02	552.16	571.49	683.56
180	552.15	553.74	570.98	679.33
200	550.97	554.09	570.96	676.13
220	551.21	554.12	570.74	673.60

Table 4.13: Average E2E Delay vs Sim Time

Sim Time	DSDV	AODV	DSR	ExDSR
120	396.91	451.68	461.38	621.13
140	403.28	451.13	458.37	628.63
160	406.94	450.85	457.10	631.37
180	411.41	449.45	456.94	633.72
200	411.11	449.23	454.73	635.67
220	414.34	449.23	453.75	637.19

Table 4.14: Throughput vs Simulation time

4.4.4 Scenario 4: All Nodes are moving on opposite direction with More Source

Here also we kept 3 sources and all the nodes including intermediate and destination all are moving on opposite directions. Here also we have kept the test speed of 15 m/sec, assigned to each source. So in this scenario the simulation results of the protocols are-

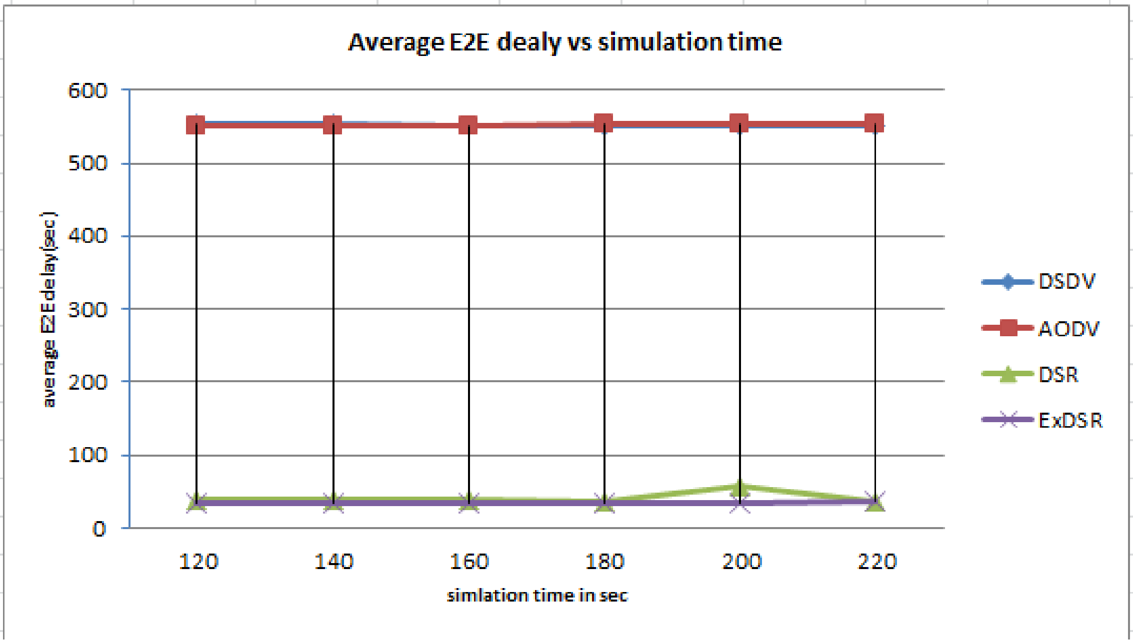

Figure 4.12: E2E Delay vs simulation time

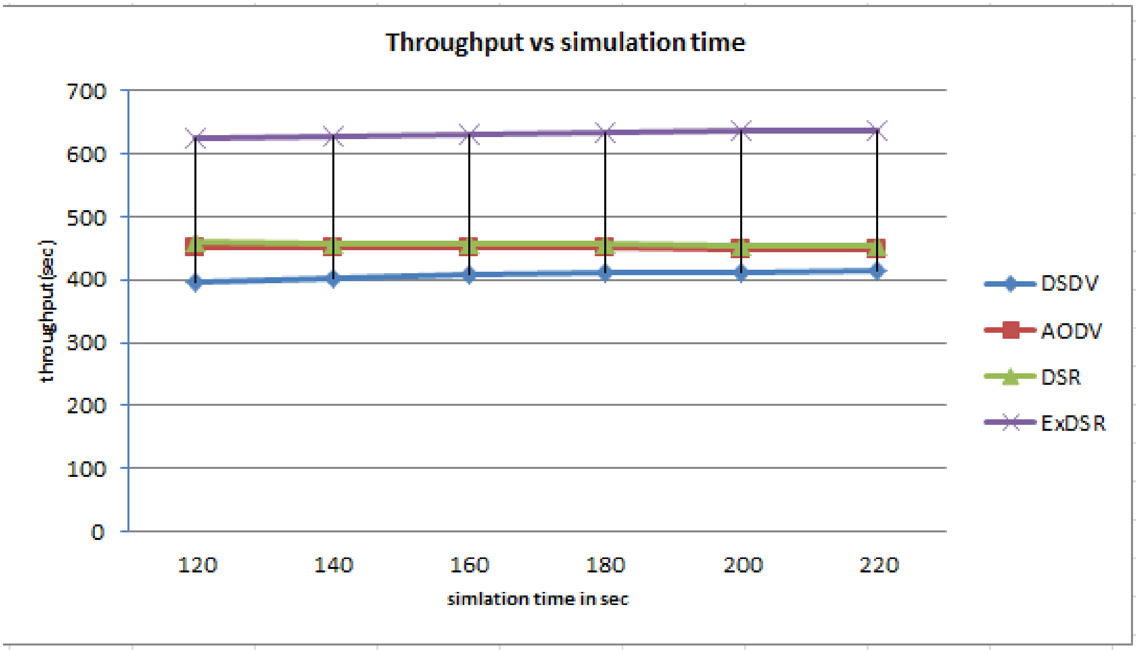

Figure 4.13: Throughput vs simulation time

PDF-Packet Delivery Ratio

Packet Delivery Fraction of all protocols while source nodes are moving upward. Table-4.4.4 Figure-4.14

Sim Time	DSDV	AODV	DSR	ExDSR
120	11.51	22.70	23.38	23.41
140	12.89	22.60	23.13	23.20
160	13.86	22.51	22.92	23.02
180	14.18	22.46	22.81	22.85
200	13.52	22.41	22.69	22.75
220	13.05	22.34	22.58	22.68

Table 4.15: Throughput vs Simulation time

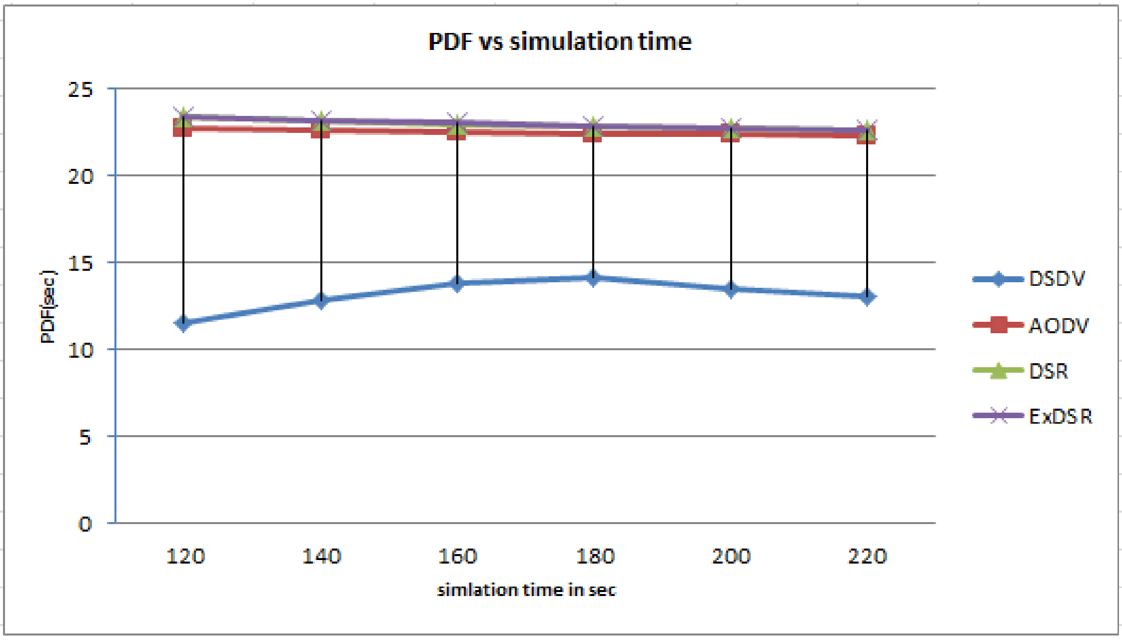

Figure 4.14: PDF vs simulation time

E2E delay-Average End to End Delay

This table contains comparatives of average end to end delay under give scenario. Table-4.4.4 Figure-4.15

Sim Time	DSDV	AODV	DSR	ExDSR
120	668.52	649.15	663.92	656.19
140	661.17	645.38	659.92	654.05
160	659.12	643.57	659.23	653.48
180	674.81	640.55	655.80	652.35
200	678.90	640.14	654.97	652.02
220	670.40	638.83	655.44	651.52

Table 4.16: Throughput vs Simulation time

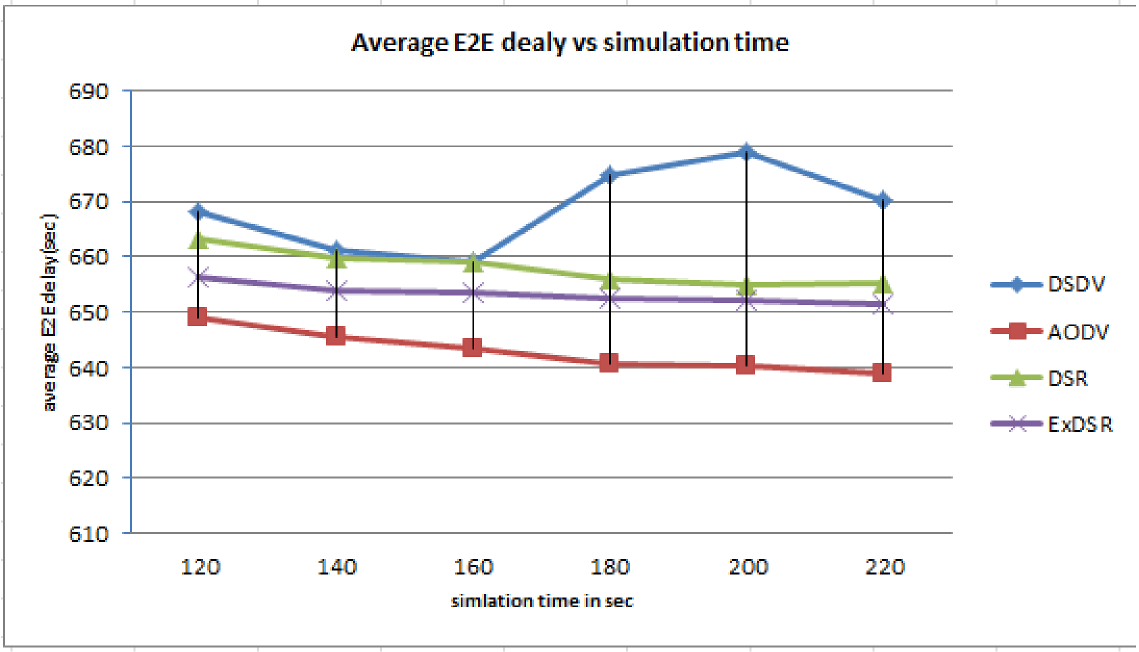

Figure 4.15: E2E Delay vs simulation time

Throughput

Below is the result of the throughput under the same scenario in kbps. Table-4.4.4 Figure-4.16

Sim Time	DSDV	AODV	DSR	ExDSR
120	206.71	407.51	419.77	420.42
140	231.65	405.93	415.40	416.67
160	248.94	404.47	411.73	413.59
180	254.78	403.62	409.97	410.74
200	257.05	402.75	407.79	408.84
220	234.57	401.63	405.82	407.71

Table 4.17: Throughput (kbps) vs Simulation time

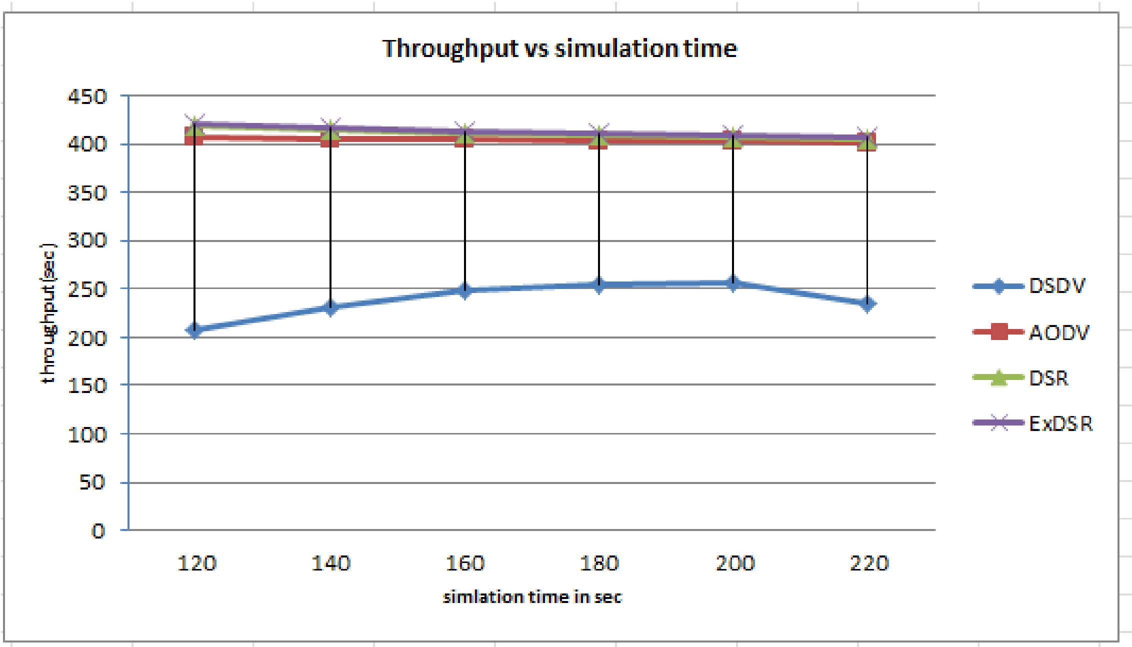

Figure 4.16: Throughput vs simulation time

Chapter 5

Conclusion

5.1 Conclusion

We have given an improvement over Dynamic Source Routing (DSR), in case of two sources having a common best path to same destination. Let's discuss the simulation result according to each case.

Case 1 Now here we observed the case 1 of very low PDF of ExDSR is 29% far better than DSDV PDF of ExDSR down performs 0.12 to 0.15 %than AODV and DSR, which can be improved by reducing the switching time. Average E2E delay of ExDSR performs 15 % better than DSDV. Average delays are 10, 10.07 % lesser than AODV and DSR. Throughput is 29.15 to 71 % better than the DSDV and 0.23 to 1.43% better than AODV. On the same ground it is better than DSR on the scale of 0.003 to 0.02%.

Case 2 In this case of low mobility of all nodes except source nodes we observed the following trends. Here also one of the node renounces the transmission at certain time say 1.8 sec here, so the other node switches to the best path available. Source nodes were kept at mobility Nodes were kept at mobility speed of 15 m/sec. On PDF parameter ExDSR outperforms DSDV from 86.0 to 99%. It has better PDF of 36.12 % than AODV. It is 0.15 % better than DSR for PDF. In average end to end delay it's performance is better than DSDV but very trivial than others. In this case the throughput is exceptionally well. ExDSR is 84.94 to 99% better PDF is also 21.2 to 25.7 % better than AODV on same matric and 0.25 to 1.62 % better than DSR.

Case 3 In this case of high mobile node movement on an expanding topology design it's performance is poor.

Case 4 On PDF parameter ExDSR outperforms DSDV from 73.79%. It has better PDF of 1.52 % than AODV. It is 0.45 % better than DSR for PDF. Average E2E delay of ExDSR performs 3 % better than DSDV. Average delays are 2, 0.59 % lesser than AODV and DSR. In this case the throughput is exceptionally well. ExDSR is 73.8 % better PDF is also 2 % better than AODV on same matric and 0.5 % better than DSR.

5.2 Future Work

So here we can say the ExDSR performs better in low mobility and common best shared path available case where a best path is captured by one source for it's entire transmission time and it is again captured by another source once it is left by the first one. So this protocol is situational kind of protocol. In future also we can extend our work to make this kind of situational protocols based on present system infrastructure. Even we can extend our work to energy efficient DSR for MANET and we can also reduce packet loss in the network more. We can also improve our algorithm in case of other network parameters change. In this work network parameters such as mobile nodes, traffic type, simulation area etc. are kept limited, in future we can observe the behaviour of this protocol by varying these parameters vastly.

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